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A new species of the genus *Themus* Motschulsky, 1858 (Coleoptera: Cantharidae) from Xizang, China, with notes on some similar species

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Abstract: A new species, *Themus rongtoensis* **sp. nov.**, is described from Xizang, China. This new species was previously confused with *T. kambaiticus* Wittmer, 1983 described from Myanmar. These two species, along with *T. lineatofemoralis* (Pic, 1917) (Nepal, Bhutan, India) and *T. meghalayanus* Wittmer, 1983 (India), are closely similar to each other. Comparisons, identification key and distribution map of these four species are provided. A structure observed on the ventrites of some species of the subgenus *Themus* Motschulsky, 1858 is newly termed as "abdominal projection", which is briefly discussed.

Keywords: Abdominal projection, aedeagus, Cantharinae, Himalayas, soldier beetle

中国西藏丽花萤属一新种，及数相似种注释（鞘翅目：花萤科）

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摘要：本文描述了中国西藏的一新种——察隅丽花萤 *Themus rongtoensis* **sp. nov.**。该新种此前被误订为依缅甸标本描述的 *T. kambaiticus* Wittmer, 1983。此两物种，连同 *T. lineatofemoralis* (Pic, 1917)（尼泊尔、不丹、印度）与 *T. meghalayanus* Wittmer, 1983（印度），彼此间极为相似。文中提供了这四种花萤的对比、分种检索表及分布图。此外，本文首次提出并简要讨论了在亚属 *Themus* Motschulsky, 1858 一些物种腹片上观察到的一种结构，将其称为"腹突（abdominal projection）"。

关键词：腹突，阳茎，花萤亚科，喜马拉雅山脉，花萤

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Introduction

The soldier beetle genus *Themus* Motschulsky, 1858 (Cantharidae, Cantharinae) is a speciose genus which includes about 250 species (Kopetz 2010, 2016; Su *et al.* 2015ab, 2016ab; Švihla 2008, 2011; Yang *et al*. 2013, 2014, 2018, 2019ab). The genus was arranged into four subgenera by Wittmer (1973, 1983, 1997), namely *Gallerucocantharis* Pic, 1913, *Haplothemus* Wittmer, 1973, *Themus* s. str. Motschulsky, and *Telephorops* Fairmaire, 1886. Švihla (2008) pointed out that based on Wittmer's subgeneric definition, both *Haplothemus* and *Themus* s. str. became polyphyletic, and he redefined the three subgenera *Haplothemus*, *Themus* s. str., and *Telephorops*. Although *Gallerucocantharis* is sometimes regarded as an independent genus (Yang & Yang 2010), the division of three or four subgenera with Švihla's subgeneric definition is presently accepted by all authors.

During the examination of the cantharid collection at the Natural History Museum, London, the author discovered an undescribed species belonging to the subgenus *Themus*. This species closely resembles *T. kambaiticus* Wittmer, 1983 and was previously misidentified as it by Wittmer (1983). In the course of describing this new species, it was compared with *T. kambaiticus* and two other morphologically similar species, *T. lineatofemoralis* (Pic, 1917) and *T. meghalayanus* Wittmer, 1983. In this paper, comparisons of these four species, along with an identification key and a distribution map are provided. Furthermore, a structure observed on the ventrites of some species of the subgenus *Themus* Motschulsky, 1858 is newly termed, described, and briefly discussed.

Material and methods

Specimens examined in this study are deposited in Ehime University Museum, Matsuyama, Japan (**EUMJ**), Muséum National d'Histoire Naturelle, Paris, France (**MNHN**), Natural History Museum, London, UK (**NHMUK**) and Naturhistorisches Museum Basel, Switzerland (**NHMB**).

For the holotypes, verbatim label data are cited within double quotation marks (" ") for each label and the line breaks within a label are indicated by a slash (/).

All of the type specimens examined were already dissected by late Walter Wittmer. The removed abdomen and dissected genitalia were glued onto a cardboard and pinned under the card bearing the mounted body. They were usually observed as is, but the aedeagus of the new species was treated with a 10% KOH solution at 90°C for approximately 5 minutes, dehydrated in absolute ethanol for a while, then dried and examined.

Habitus was photographed using a Canon EOS 7D Mark II digital camera with a Tamron SP AF 90mm F2.8 Di Macro lens and Canon speedlight 580EX II strobes. Photographs of dissected parts were taken by iPhone 13 mini, Apple through the microscope. Photographs were focus-stacked using digital image processing software Affinity Photo 1.10.4 and then edited with GIMP 2.10.14.

The measured values and their abbreviations are as follows: **BL** = body length measured from the apex of clypeus to apices of elytra, **HW** = head width including eyes, **PL** = pronotum length along median line, **PW** = maximum width of pronotum, **EW** = humeral width of conjoint elytra, **EL** = elytral length. However, as is often the case in Cantharidae, the elytra of the holotype of the new species are recurved upwards due to desiccation, and thus the values of BL and EL may not be accurately measured.

Males of some *Themus* s. str. species possess variously shaped projections on their ventrites. This structure is here termed the "abdominal projection" (see also Discussion).

A distribution map was created with a shapefile downloaded from Natural Earth project and WorldClim websites by using QGIS 3.30.3, based on the distribution data given in the literature cited and this study. When only a broad locality name was given in the original literature, a provisional plot was placed near the center of the indicated area.

Taxonomy

Themus (s. str.) *rongtoensis* sp. nov. 察隅丽花萤

https://zoobank.org/86F42C07-6348-423F-8754-CE794C7B8A2F

Figs. 1A; 2A–D, I, J

Themus (s. str.) *kambaiticus*: Wittmer 1983: 228 (part; misidentification).

Type material. Holotype, ♂ (Fig. 1A; NHMUK), "S. E. TIBET: / RongTö Valley / 6500 ft. 21. V. 1933.", "F.Kingdon Ward / & R.J.H.Kaulback / B.M. 1934–41.", "Themus (s. str.) / kambaiticus / Wittm. / det. W. Wittmer". This unique holotype has lost the entire left middle leg, all parts of the right hind leg except the femur, and the claws of the left hind leg.

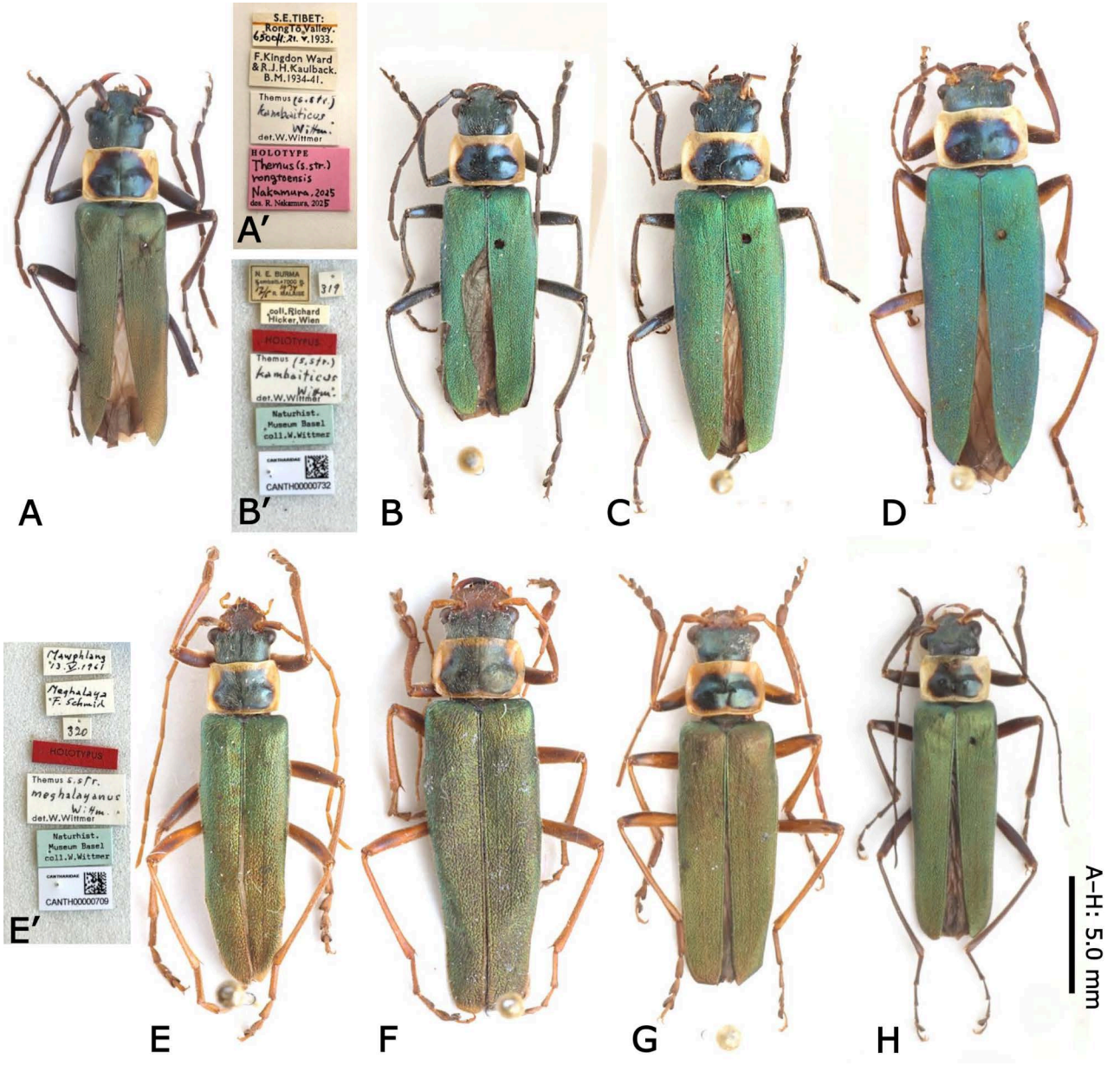

FIGURE 1. Dorsal habitus of *Themus* spp.: **A** *T. rongtoensis* **sp. nov.**, holotype, male (**A'** labels) **B** *T. kambaiticus* Wittmer, holotype, male (**B'** labels) **C & D** same species, paratypes, females **E** *T. meghalayanus* Wittmer, holotype, male (**E'** labels) **F** same species, paratype, female **G, H** *T. lineatofemoralis* (Pic), non-type specimens, males. Labels are not to scale.

Type locality. China: Xizang, Rongtö Valley. According to Men *et al*. (2021), it lies in Zayu, Nyingchi, 28°54′23.1″N, 96°39′27.9″E.

Description. Male, holotype (Fig. 1A). BL 15.9 mm. Head metallic dark blue, mouthparts black, apical halves of mandibles brown, antennae dark brown, though anteomeres 1–4 reddish brown ventrally, pronotum yellow, with a large metallic dark blue marking in center of disc, scutellum metallic dark blue, elytra metallic olive green, femora metallic dark blue, other parts of legs dark brown, meso- and metathorax metallic dark blue, ventral side of abdomens dark brown, with lateral and posterior margins of ventrites I–VI and entire ventrite VII except for abdominal projection yellowish brown. Body densely covered with white short pubescence, sparsely mixed with long erect pubescence on clypeus.

Head rounded, HW 3.06 mm, HW/PW 1.07; eyes globular and moderately protruding, interocular distance 5.25 times as wide as the diameter of an eye; mandible arcuate and pointed at apex; apical segments of labial and maxillary palpomere knife-shaped; antennae filiform and slightly flatted, reaching basal 3/5 of elytra, comparative lengths of antennomeres as follows: 1.96 : 1.37 : 1 : 2.08 : 2.02 : 2.23 : 2.2 : 2.06 : 1.93 : 1.63 : 1.78, antennomeres 5–10 each with a longitudinal groove on apical half.

Pronotum rectangular, anterior and posterior margins feebly arcuate, lateral margins slightly converging posteriorly and slightly emarginated in the middle, anterior and posterior angles obtuse and rounded; PL 2.25 mm, PW 3.27 mm, PL/PW 1.46; disc moderately convex at postero-lateral area with a medio-longitudinal furrow not reaching the anterior and posterior margins. Scutellum trapezoidal and with round apex. Elytra long, parallel in lateral sides, apex slightly pointed, disc coarsely and densely punctate and with two longitudinal costae on each elytron, EL 10.82 mm, EW 4.01 mm, EW/PW 1.23, EL/EW 2.70. Legs slender, each femur mostly straight, each tibia feebly arcuate.

Abdominal ventrite VII (Fig. 2I, J) with posterior margin deeply emarginate, lateral corners of the emargination roundly protruding, median part of the emargination forming a triangular projection not exceeding the lateral corners; abdominal projection on anterior median part of ventrite VII rounded rectangular, equal in length and height, protruding ventrally. Sternite IX (Fig. 2D) slender, ensiform, apex acutely pointed, anterior portion broadened and rounded, then narrowing into a parallel-sided section before expanding again.

Aedeagus (Fig. 2A–C): ventral process of each paramere lamelliform, inner and outer margins nearly parallel, lateral halves of posterior margin quadrately projected in ventral view, curved dorsally, with the projection directed ventrally, appearing bifurcate at apex in lateral view; conjoint dorsal plate of parameres distinctly longer than ventral process, gradually narrowing apically, apex distinctly emarginate, with lateral corners rounded and protruding in ventral view, parallel in basal half, narrowing in apical half, with a large triangular projection directed ventrally on each side, its apex contacting ventral process in lateral view; laterophyse of median lobe fused medially, very short and invisible from ventral view, apices triangularly projected in ventral view, bisinuate in apical view

Differential diagnosis. This new species resembles *T. kambaiticus* Wittmer but can be distinguished by the differently shaped ventral process of aedeagus, longer and darker elytra, and pronotum marking extending to the anterior margin. The new species is also similar to *T. meghalayanus* Wittmer and *T. lineatofemoralis* (Pic), but can be distinguished by its dark brownish legs, whereas the latter two generally have reddish coloration on whole or part of the legs, as well as by the different shape of ventral process the aedeagus.

Distribution. China (Xizang).

Etymology. Named after its type locality, Rongtö Valley.

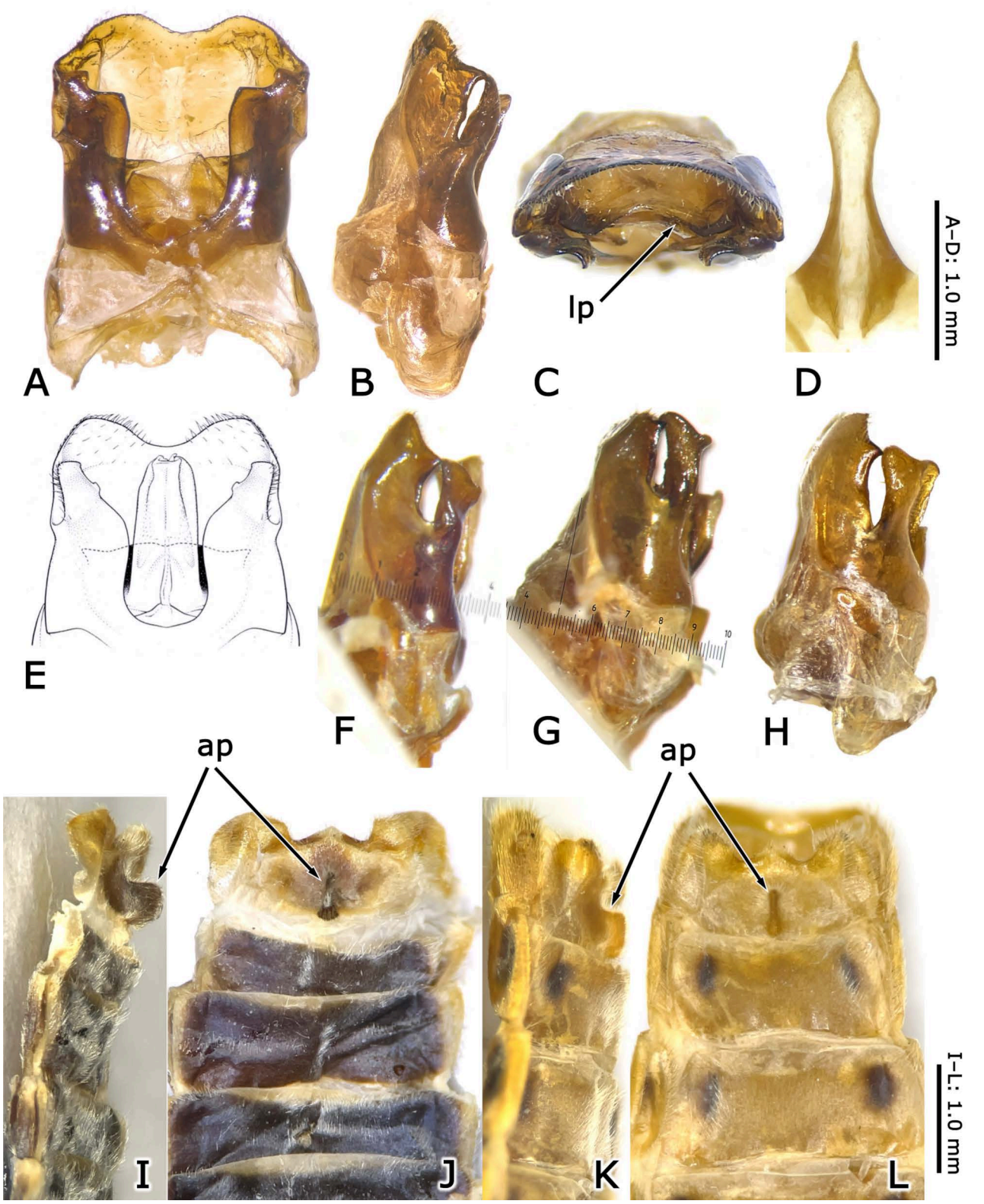

FIGURE 2. Male diagnostic characteristics of *Themus* spp.: **A–D, I, J** *T. rongtoensis* **sp. nov.**, holotype **E, F** *Themus kambaiticus* Wittmer, holotype (**E** reproduced from Wittmer, 1983) **G** *T. meghalayanus* Wittmer, holotype **H, K, L** *T. lineatofemoralis* (Pic), non-type specimen. **A, E** aedeagus, ventral view **B, F–H** aedeagus, lateral view **C** aedeagus, caudal view (lp: laterophyse) **D** sternite IX, ventral view **I, K** ventrites, lateral view **J, L** ventrites, ventral view (ap: abdominal projection). E–H are not to scale.

Themus (s. str.) *kambaiticus* Wittmer, 1983

Figs. 1B–D; 2E, F

Themus (s. str.) *kambaiticus* Wittmer, 1983: 228 (original description; type locality: "NE Burma, Kambaiti"), figs. 46 (aedeagus), 118 (female sternite VIII); Wittmer 1997: 261 (diagnosis); Okushima 2002: 136, fig. 1 (new record from Vietnam); Kopetz 2010: 166 (synonymic notes, additional records).

Themus (s. str.) *kambaiticomimus* Wittmer, 1997: 261, figs. 87–88 (type locality: China, Yunnan, Galiogong); Kazantsev & Brancucci 2007: 272 (catalogue). Synonymized by Kopetz (2010).

Type materials examined. Holotype, ♂ (Figs 1B; 2E, F; NHMB), "N. E. BURMA / Kambaiti 7000 ft. / 17/5 1934 / R. MALAISE", "319", "coll. Richard / Hicker, Wien", "HOLOTYPUS", "Themus (s. str.) / kambaiticus / Wittm. / det. W. Wittmer", "Naturhistorisches / Museum Basel / Coll. W. Wittmer", "CANTHARIDAE [QR code] / CANTH00000732". **Paratype,** ♀ (Fig. 1C; NHMB), same collecting data as the holotype but "2000 m / 12–17/6.34". **Paratype,** ♀ (Fig. 1D; NHMB), same collecting data as the proceeding but "1/6.1934".

Notes. The holotype male and the first female paratype lack reddish coloration on their legs, whereas in the second female paratype, the tibiae, anterior margins of the fore femora, and posterior margins of the mid and hind femora are reddish brown, which is reminiscent of *T. lineatofemoralis* (Pic).

Distribution. China (Yunnan); N. Vietnam; NE. Myanmar.

Themus (s. str.) *meghalayanus* Wittmer, 1983

Figs. 1E, F; 2G

Themus (s. str.) *meghalayaus* Wittmer, 1983: 229 (original description; type locality: "Indien, Meghalaya, Mawphlang"), figs. 47 (aedeagus), 119 (female sternite VIII).

Type materials examined. Holotype, ♂ (Figs 1E; 2G; NHMB), "Mawphlang / 13. V. 1961", "Meghalaya / F. Schmid", "320", "HOLOTYPUS", "Themus s. str. / meghalayanus / Wittm. / det. W. Wittmer", "Naturhistorisches / Museum Basel / Coll. W. Wittmer", "CANTHARIDAE [QR code] / CANTH00000709". **Paratype,** ♀ (Fig. 1F; NHMB), same collecting data as the holotype.

Distribution. India (Meghalaya).

Themus (s. str.) *lineatofemoralis* (Pic, 1917)

Figs. 1G, H; 2H; 2K, L

Cantharis lineatofemoralis Pic, 1917: 4 (original description; type locality: "Bengale").

Themus (s. str.) *lineatofemoralis*: Wittmer 1983: 226 (notes, distribution), figs. 44 (aedeagus), 116 (female sternite VIII); Okushima 1999: 52 (distribution records), fig. 2 (habitus); Kopetz 2004: 121 (distribution records); Kopetz 2006: 267 (distribution records); Kazantsev & Brancucci 2007: 272 (catalogue); Kopetz, 2009: 341 (checklist).

Themus khasianus: Champion 1926: 130 (part; misidentification) (nec Gorham 1889).

Type material examined. Holotype, ♀ (MNHN), "Sikkim / Kurseong / 1884", "lineatofemoralis / Pic", "TYPE", "379", "Themus (s. str.) / lineatofemoralis / (Pic) / det. W. Wittmer".

Other materials examined. 1 ♂ (Figs 1G; 2H, K, L; NHMB), India, Darjeeling, Bhakta B., Ralle, 16. IV. 1987; 1 ♂ (Fig. 1H; EUMJ), E. Nepal, Basantapur, 2,300 m, 27°07′N, 87°24′E, 8. V. 1972, Malaise Trap, Kyushu Univ. leg. More than a hundred specimens from India and Nepal in MNHN, NHMUK and NHMB are also examined.

Supplementary description. Abdominal ventrite VII (Fig. 2K, L) with posterior margin deeply emarginate, lateral corners of the emargination roundly protruding, median part of the emargination forming a triangular projection not exceeding the lateral corners; abdominal projection on anterior median part of ventrite VII rounded rectangular, approximately twice as long as high, protruding ventrally.

Notes. This species exhibits considerable intraspecific variation. The antennae are usually reddish brown on

the basal 2 or 3 segments and dark brown on the remaining segments (as in the holotype), but the coloration ranges from entirely reddish brown (Fig. 1G) to entirely brownish black in some individuals (Fig. 1H). The legs typically show a color pattern in which the external margins of the femora and tibiae are black and the remaining parts reddish brown (as in the holotype), but the extent of the reddish brown areas vary greatly. The tibiae sometimes become entirely reddish brown (Fig. 1G) or blackish (Fig. 1H). Abdominal coloration varies from specimens in which ventrites I–VI are yellowish brown with a pair of lateral black spots, and ventrite VII is uniformly yellowish brown (Fig. 2L), to specimens that are almost entirely blackish as in *T. rongtoensis* **sp. nov.** The shape of the pronotal marking also shows some variation. Despite such variation in external morphology, the characteristics of the aedeagus, which are important in the taxonomy of Cantharidae, are stable.

Distribution. India (Sikkim (Kurseong), Uttarakhand (Kumaon), West Bengal (Darjiling)); Nepal; Bhutan.

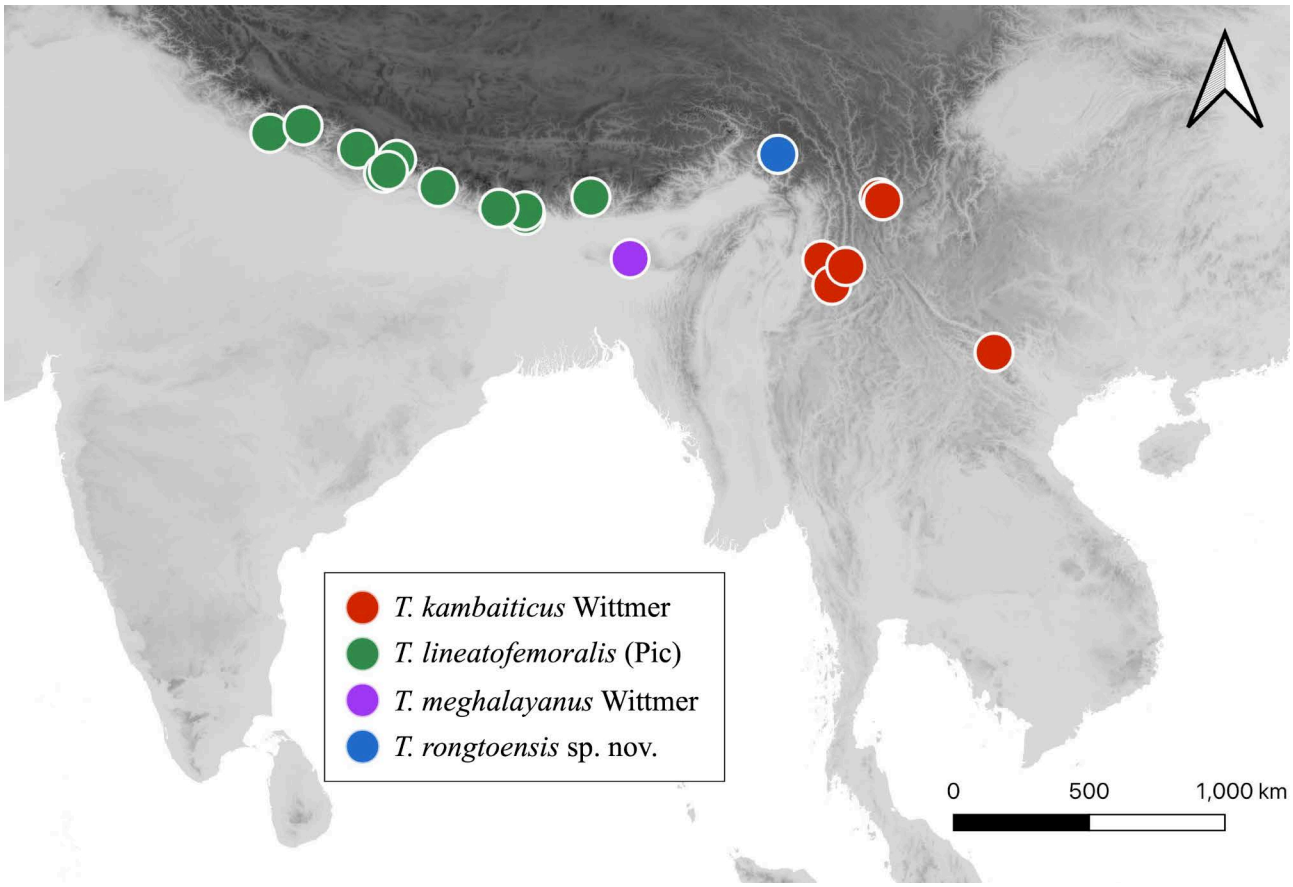

FIGURE 3. Distribution map of *Themus rongtoensis* **sp. nov.**, *T. kambaiticus* Wittmer, *T. meghalayanus* Wittmer and *T. lineatofemoralis* (Pic).

Discussion

The above-mentioned new species and the following three species are similar to one another in the following characteristics of the aedeagus: ventral process of each paramere is lamelliform and curved dorsally; conjoint dorsal plate of parameres is neither divided nor deeply emarginate medially; and laterophyse of median lobe is medially fused, very short, and invisible in ventral view. Although the female of *Themus rongtoensis* **sp. nov.** is unknown, the remaining three species share a similar shape of female sternite VIII (Wittmer 1983), which is an important character for species identification of females in this genus. Considering these four species exhibit allopatric distributions in South and Southeast Asia (Fig. 3), they most likely represent a single species group derived from a common ancestor.

The abdominal projection has been largely overlooked in previous researches. However, it has been confirmed in various species of *Themus* (s. str.) based on the author's unpublished observations and should not be disregarded in future descriptions or redescriptions. As this projection is found only in males, it may be involved in copulation, like the aedeagus, and thus may exhibit specific characteristics. Because the closely related *T. rongtoensis* **sp. nov.** and *T. lineatofemoralis* (Pic) share similarly shaped abdominal projections (Fig. 2I–L), this structure not only has potential taxonomic value at the species level but may also provide insights into phylogenetic relationships among species. Its utility should be tested across clearly defined species groups within *Themus* (s. str.), such as the *T. senensis* group (Yang *et al*. 2014) in the future study.

In the present study, intraspecific variation in external morphology was observed in several species. Therefore, reliable species identification is given by examination of the aedeagus, although these species can also be identified based on their distributions. A key to the four species is provided below.

1 Ventral process of each paramere as long as conjoint dorsal plate of parameres and conjoint dorsal plate of parameres without any projection directed ventrally in lateral view (Fig. 2G); antennomeres 2–11, tibiae and tarsi entirely reddish brown (Fig. 1E, F).....***T. meghalayanus* Wittmer**

\- Ventral process of each paramere shorter than conjoint dorsal plate of parameres and conjoint dorsal plate of parameres with a large triangular projection directed ventrally in lateral view (Fig. 2B, F, H); antennae, tibiae and tarsi usually blackish at least partially (Fig. 1A–D, H) (rarely fully reddish brown in *T. lineatofemoralis*)...**2**

2 Ventral process of each paramere narrowed toward the apex from the middle in ventral view (Fig. 2E).....***T. kambaiticus* Wittmer**

\- Ventral process of each paramere parallel-sided at the middle in ventral view (Fig. 2C; Wittmer 1983: Fig. 44).....**3**

3 Conjoint dorsal plate of parameres only shallowly emarginate at the middle in ventral view (Wittmer 1983: Fig. 44); ventral process of each paramere thicker and its apex prominently produced ventrally in lateral view(Fig. 2H); antennae and legs usually with reddish parts (Fig. 1G).....***T. lineatofemoralis* (Pic)**

\- Conjoint dorsal plate of parameres clearly emarginate at the middle in ventral view (Fig. 2A); ventral process of each paramere thinner and its apex slightly produced ventrally in lateral view (Fig. 2B); antennae and legs entirely blackish (Fig. 1A).....***T. rongtoensis* sp. nov.**

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